

# Individual decentralized AC system: essential for CN2050 New refrigerant development

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# CONTENTS

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1. Individual decentralized AC system: essential for CN2050
2. New refrigerant development
3. Summary

# 1. Individual decentralized AC system: essential for CN2050

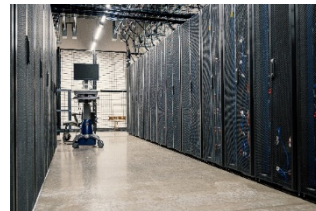
## Heat pump/refrigeration cycle technology used in various fields

HVAC/R industry will contribute to the sustainable improvement of people's lives and welfare through **cooling / heating / freezing / hot water supply using the refrigeration cycle.**

### Industrial



Industrial heat pump



Process cooling/  
Cooling ICT server rooms

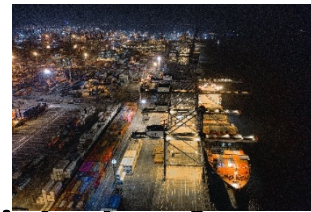
### Supply chain (Cold chain)



Food Showcase



Medical  
Supply Chain



Freight (reefer container, etc.)

### Human Comfort



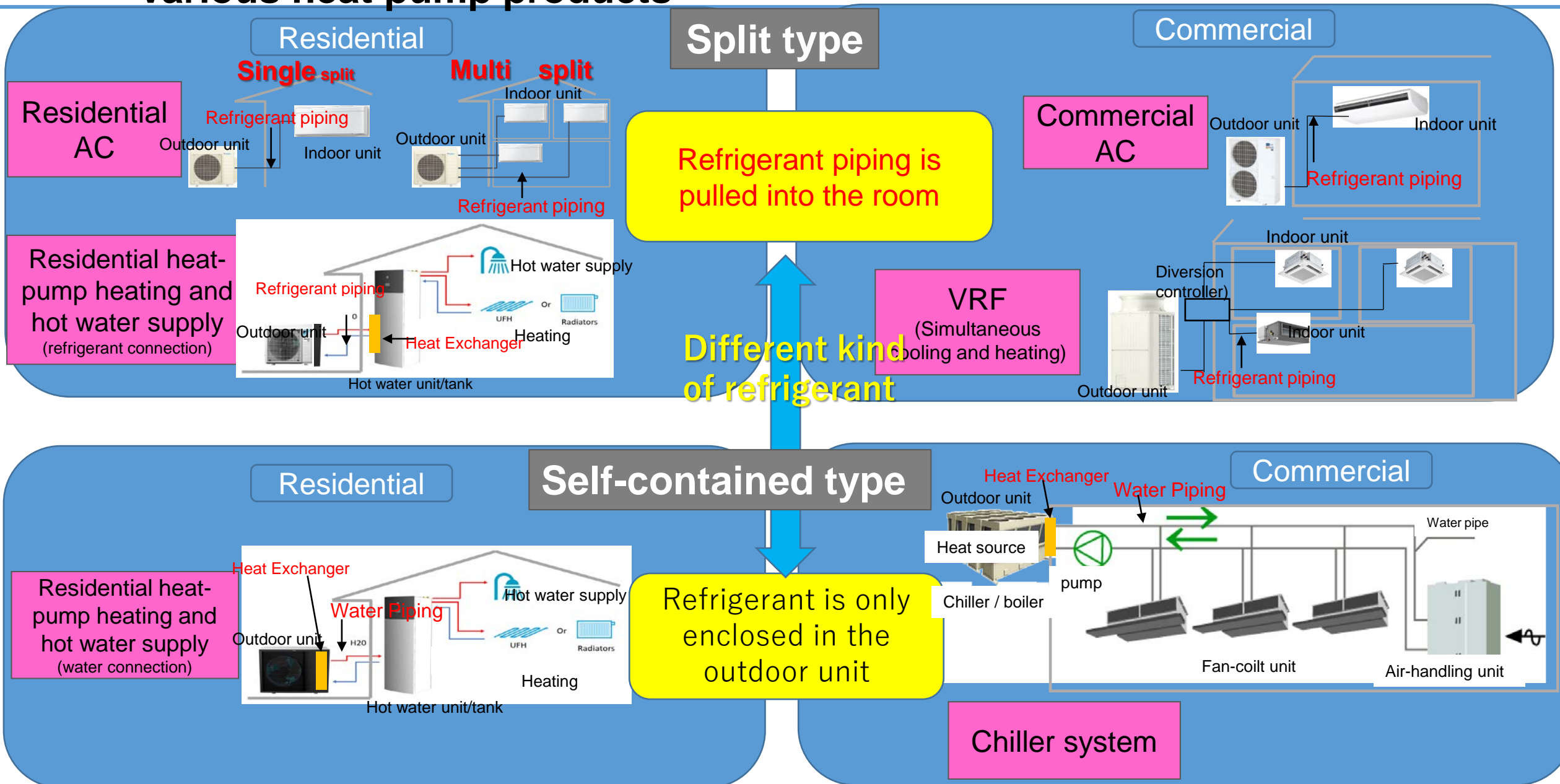
Comfort cooling/heating:

All images are for illustration purpose only.

- To achieve “carbon neutrality” with sustainability, **cooling and heating are essential**
- **JRAIA will continue to work together with the government and academia** toward the realization of a carbon neutral society while considering **S+3Es** (safety, environmental performance, energy conservation, and economic efficiency).

# 1. Individual decentralized AC system: essential for CN2050



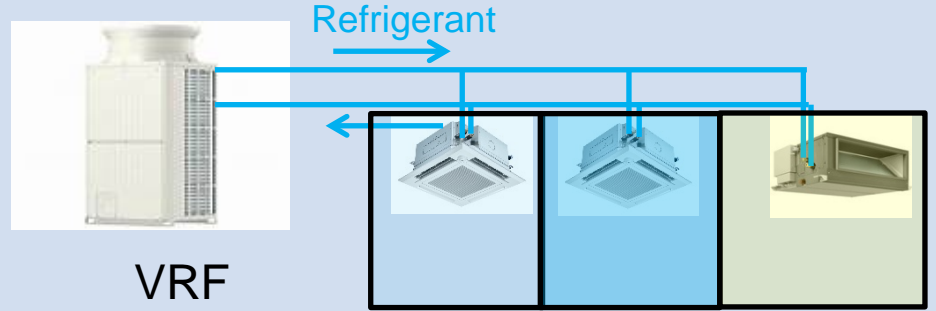
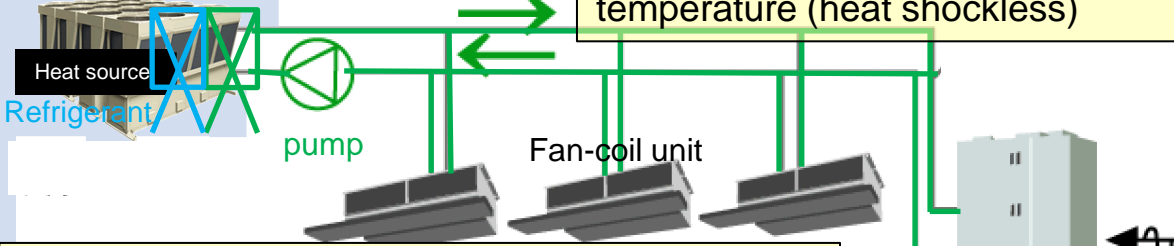
## Various heat pump products



# 1. Individual decentralized AC system: essential for CN2050

## Individual decentralized AC system and central AC system

Both Individual decentralized AC systems and central AC systems have their distinct advantages. However, **for small and medium-sized buildings, the individual decentralized air conditioning system is superior** in terms of **economy, energy saving, quick response**, and is **chosen as essential system**.

	Individual decentralized AC system (direct expansion)	Central AC system (Non-direct expansion)
System type	<b>Split air conditioners, VRF</b> , etc. 	Water system, Duct system, Combined system 
Building Size	Suitable for <b>small to medium</b> sized buildings	Suitable for <b>medium to large</b> sized buildings
Advantages	<div> <p><b>① High Efficiency</b> No need for heat exchange to water</p> </div> <div> <p><b>② Quick response</b> Quick responsiveness due to direct heat transfer with refrigerant.</p> </div> <div> <p><b>③ Economic</b> Lower cost compared to central AC</p> </div> 	<div> </div> <div> <p><b>① Centralized control</b> The entire building can be controlled collectively</p> </div> <div> <p><b>Heat exchange from refrigerant to water (approx. 10% energy loss)</b></p> </div> <div> <p><b>② Constant temperature</b> Control the building at a constant temperature (heat shockless)</p> </div> <div>  </div> <div> <p><b>③ Small Installation space</b> The installation space for the heat source is relatively small. <b>(suitable for large buildings)</b></p> </div>

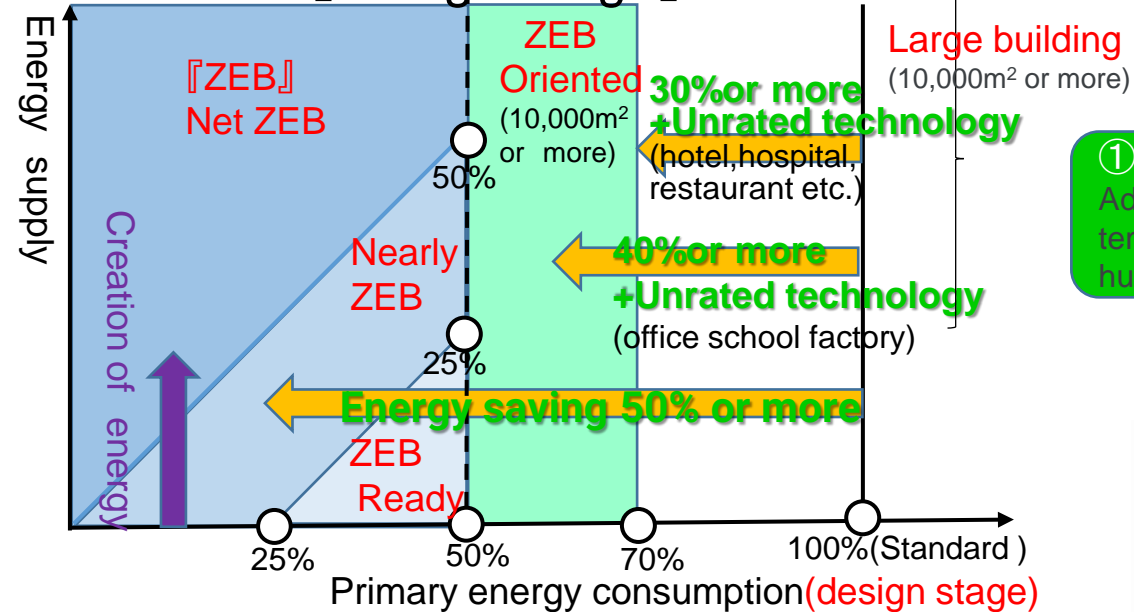
# 1. Individual decentralized AC system: essential for CN2050

## Advantage of direct expansion individual AC system

ZEB(Zero Energy Building)is essential to achieve carbon neutrality.

- (1)【Design Stage】 Japanese government has shown the roadmap plan enhance ZEB in the buildings to enhance 4 categories.  
 ①『ZEB』(net-zero), ②Nearly ZEB(75% or more), ③ZEB Ready(50% or more), ④ZEB Oriented in large buildings (10,000m<sup>2</sup> or more), Energy saving of 30% or more and unappreciated technology as a technically difficult area  
 (2) 【Operational Stage】 Combining the rapid response and various sensors in direct expansion air conditioning enables detailed energy-saving control and comfortable control, and further energy-saving can be expected at the operational stage.

### 【Design Stage】

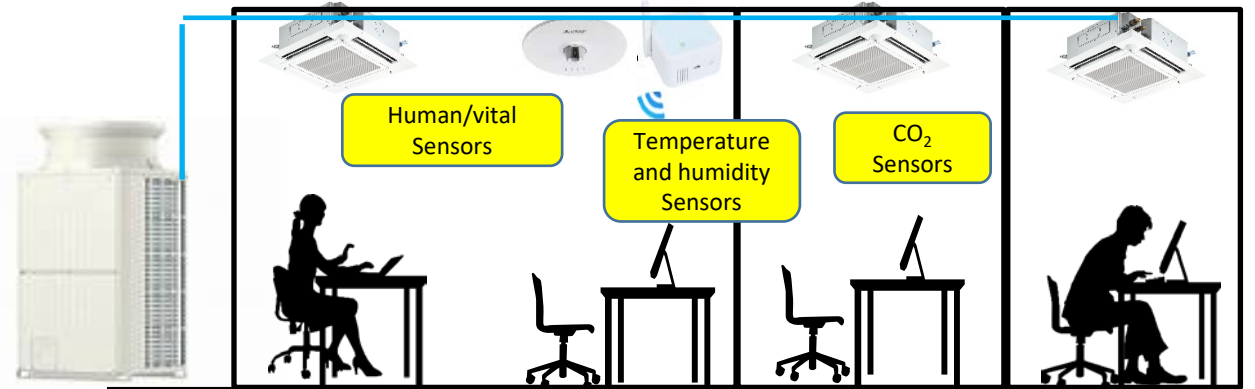


Japan's concept of Zero Energy Building

### 【Operational Stage】

Taking advantage of the quick thermal response of the refrigerant, Fine-tuned comfort and energy-saving control

- ① Adjust to the load  
Adjustable using temperature, humidity, human sensors, etc.
- ② Minimum energy control  
Control with the minimum amount of energy required by utilizing sensors.
- ③ Comfortable control  
A comfortable space can be realized by combining human detection, vital sensors and airflow.



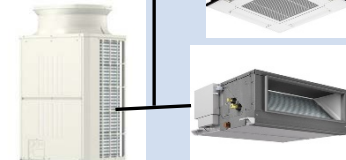


### 【Design Stage】

## 2. New refrigerant development (for direct expansion ACs)

### High-performance/low-GWP refrigerant required for direct expansion ACs

HFO-based low GWP refrigerants are the **only candidate** for **medium- to large split ACs**.  
**HFO refrigerants** are **subject to the European PFAS proposal**, careful consideration is required so as not to lose an effective means of CO2 reduction.

		R290	CO2	R32, R454B, etc.	New HFO
Small split AC (6kW ≤) 	Safety	△ (A3)	△(high pressure)	○(A2L)	○(A2L)
	GWP	○ (<10)	○ (<10)	△(<750)	○ (1~150)
	Performance/Economics	○	x (low performance)	○	△~○
	challenges	<b>Safety Measure</b>	<b>impractical</b>	Medium GWP	<b>PFAS, Stability, Performance</b>
Medium/Large split AC (<6kW) 	Safety	<b>x (Flammability)</b>	△(high pressure)	○	○(A2L)
	GWP	○ (<10)	○ (<10)	△(<750)	○ (1~150)
	Performance/Economics	△	x (low performance)	○	△~○
	challenges	<b>impractical</b>	<b>impractical</b>	Medium GWP	<b>PFAS, Stability, Performance</b>
VRF 	Safety	<b>x (Flammability)</b>	△(high pressure)	○	○(A2L)
	GWP	○ (<10)	○ (<10)	△(<750)	○ (1~150)
	Performance/Economics	x	x (low performance)	○	△~○
	challenges	<b>impractical</b>	<b>impractical</b>	Medium GWP	<b>PFAS, Stability, Performance</b>

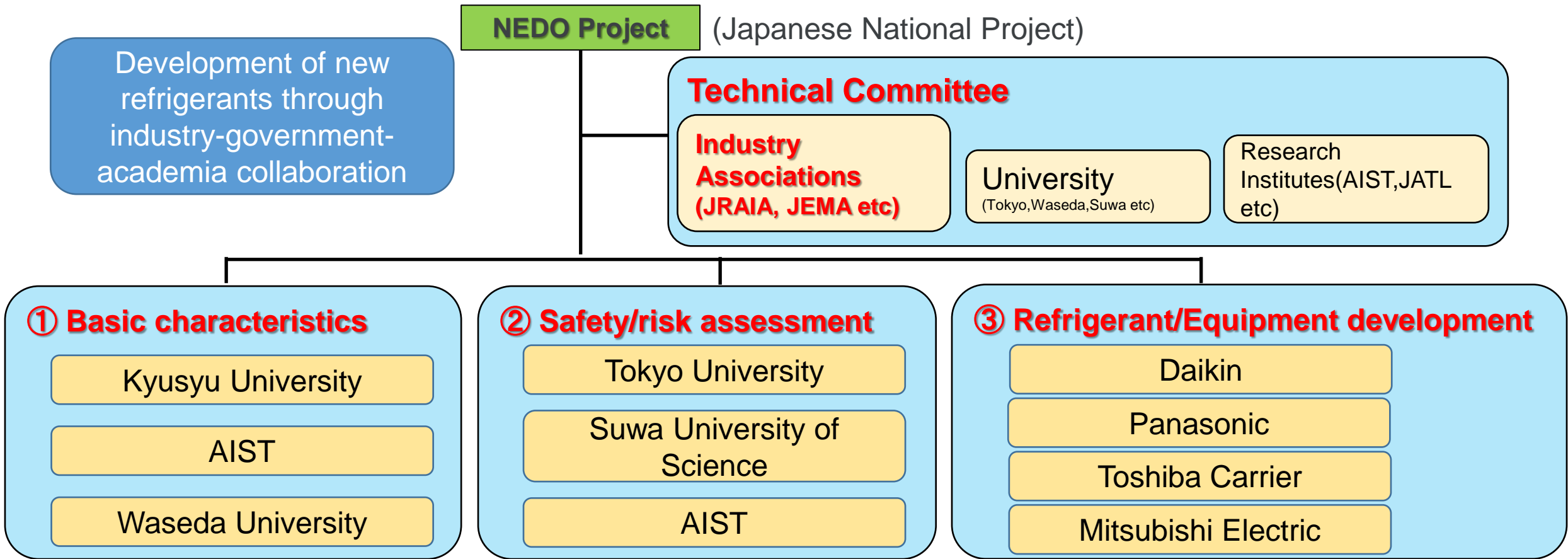
**No natural refrigerant candidate**

**Need New refrigerants**

# 2. New refrigerant development (for direct expansion ACs)

## NEDO project

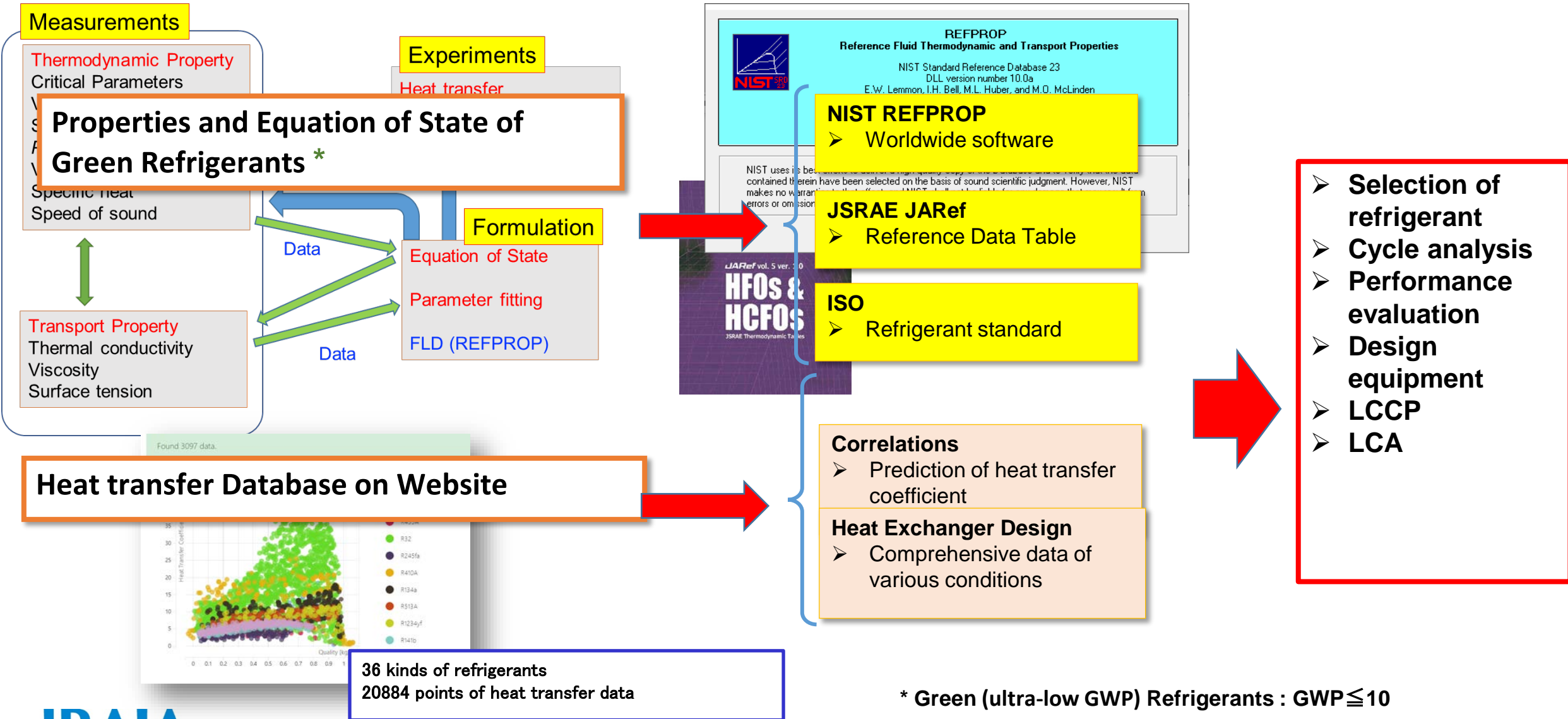
NEDO Development of next-generation refrigerant refrigeration air conditioning technology and evaluation methods that can achieve energy saving and low temperature effects (2018-2022)





# 2. New refrigerant development (for direct expansion ACs)

## NEDO Project: Search and Evaluation of Low GWP Refrigerants



\* Green (ultra-low GWP) Refrigerants :  $GWP \leq 10$

## 2. New refrigerant development (for direct expansion ACs)

(Reference) Refrigerants evaluated for thermodynamic properties by NEDO (2018~2022 GWP < 150)

(Reference)	Refrigerants	GWP
	HFO1336mzz(E)	16
	HCFO1224yd(Z)	1
	HFC32/HFO1123/HFO1234yf	(21.2/59.5/19.3%), etc.
	HFO1123	1
	HFO1123/CF3I	(50/50%), etc.
	HHC290/HFO1234yf	(50/50%), etc.
	HFO1123/HC290	(80/20%)
	HFO1123/HC290/HFO1234yf	(48/12/40%), etc.
	HFO1234yf/HFO1336mzz(E)	(40/60%)
	HFO1234ze(E)/HFO1336mzz(E)	(40/60%)

From the Final Report of the Japan Society of Refrigeration and Air Conditioning Engineers

※HFO1132(E) mixed refrigerant will be evaluated after this year.

**Technical problems** still remain in terms of **performance** and the **stability of the refrigerant**. In order to solve these problems, **NEDO will continue** to evaluate refrigerants over several years and consider their practical application.

# 3. Summary

## JRAIA's Priorities to achieve CN2050

JRAIA considers the following three points are important to realize CN2050.

### ① **Basic Concept of S+3Es**

In order to realize a sustainable carbon-neutral society, a well-balanced approach that considers S+3Es (safety, environmental performance, energy conservation, and economic efficiency) is essential.

### ② **Heat pump technology is indispensable for the realization of carbon neutral 2050.**

Heat pump technologies are utilized not only as hot water supply, but also in various fields such as air conditioning and cold chain with refrigeration equipment.

### ③ **Importance and Issues of Direct expansion AC**

Direct expansion air conditioning suitable for small and medium-sized buildings is essential for carbon neutrality. However, there are no low GWP natural refrigerants that can be used, and the development of new refrigerants is awaited.

### ④ **A new low GWP HFO refrigerant is being developed under the framework of NEDO in JAPAN**

NEDO is developing refrigerants centered on HFO refrigerants that can be used for direct expansion ACs. However, many HFO refrigerants are subject to the proposed European PFAS regulations.

In order to prevent the use of direct expansion air conditioning, which is indispensable for carbon neutrality, it is necessary to respond carefully and wisely to regulations.

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**Thank you for your attention**